भारतीय मानक

Indian Standard

IS 10702 : 2023

हवाई चप्पल — विशिष्टि

(तीसरा पुनरीक्षण)

Hawai Chappal — Specification

(Third Revision)

ICS 61.060

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Footwear Sectional Committee, CHD 19

FOREWORD

This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Footwear Sectional Committee had been approved by the Chemical Division Council.

The *hawai chappal* which serves as a light duty footwear for general use is very popular in India. This *chappal* may be washable, water-proof and may not require any polish. The straps of these *chappal* are changeable and may be replaced by the users.

This standard was originally published in 1983 and subsequently revised in 1985. In the first revision, hardness for the bottom material was expressed in shore A durometer hardness along with the test method. The value for the compression set at constant stress was raised, the method of test for change in hardness after ageing at 100 °C ± 1 °C for 24 h and split-tear strength were also incorporated. In the original standard and its subsequent first revision, rubber sole with uniform thickness was prescribed.

In second revision of the standard in 1992, rubber *hawai chappal* with ‘taper-sole design’ was introduced with the thickness of the taper-sole varying at toe and heel portions depending on the size of the rubber *hawai chappal*. Two types of rubber *hawai chappal* were prescribed based on the thickness of the sole, which are rubber sole with uniform thickness and rubber sole with taper-design. The thickness of the strap wings were deleted in the second revision and left to the agreement between the purchaser and the supplier. The hardness of the strap rubber was also reduced.

In this revision of the standard, Committee felt a need to revise the standard with a view to update the standard based on the experience of last three decades and on the currently available data.

Following changes have been incorporated in the current revision:

a) Title modified to *'Hawai chappal* — Specification';

b) Amendments 1 and 2 incorporated; and

c) Scope widened to include *hawai chappal* made from polymers and their combinations thereof as these are now widely available commercially.

The composition of Committee responsible for formulation of this standard is given in Annex J.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

Indian Standard

HAWAI CHAPPAL — SPECIFICATION

(Third Revision)

1 SCOPE

This standard prescribes requirements and methods of sampling and tests for *hawai chappal* for general purposes.

2 REFERENCES

The standards given below contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreement based on this Indian Standard are encouraged to investigate the possibility of applying the most recent editions of these standards:

IS No.	*Title*
IS 2050 : 1991	Glossary of terms relating to footwear (*first revision*)
IS 3400	Methods of test for vulcanized rubbers:
(Part 10/Sec 1) : 2020	Compression set section, Section 1 At ambient or elevated temperatures (*second revision*)
(Part 16) : 1974	Measurement of cut growth of rubber by the use of the ross flexing machine
IS 6191 (Part 4) : 2018	Methods of micro-biological, colour fastness and microscopical tests for leather: Part 4 Colour fastness to cycles of to-and-fro rubbing
IS 6368 : 1971	Methods for sampling of rubber and rubber combination footwear
IS 12240 (Part 5) : 1988	Methods of test for polyvinyl chloride boots: Part 5 Determination of lead content
IS 15298 (Part 1) : 2015	Personal protective equipment: Part 1 Test methods for footwear (*second revision*)
IS 15844 : 2010	Sports footwear — Specification
IS 16645 : 2018	Moulded plastics footwear — Lined or unlined polyurethane boots for general industrial use — Specification
IS 17011 : 2018	Chemical requirements for footwear and footwear materials

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 2050 shall apply in addition to the following:

Hawai chappal — Any open toed having flat or tapered sole with a polymeric strap or thong attached through stud that goes between the toes to hold the *chappal* in place.

4 REQUIREMENTS

4.1 Material

4.1.1 *Bottom Material*

The bottom shall be made from natural or synthetic rubber or polymer or their combinations thereof. It may be made by either vulcanization, compression or moulding process.

4.1.2 *Strap Material*

The strap shall be solid or cellular made from natural or synthetic rubbers or polymers for example (TPR/EVA/PU/TPU etc) or combinations thereof. Strap may be made by either vulcanization, compression or moulding process.

4.1.3 The bottom sole and strap shall be homogenous and free from blisters, cavities, collapses and blemishes. The die marking shall be neat and clean and the surface shall be reasonably good finish.

4.1.4 The shape, design, colour and surface of the sheets of components shall be as agreed between the purchaser and the manufacturer. A typical illustration of *hawai chappal* is given in Fig. 1.

4.2 The recommended length of the *hawai chappal* is given in Annex A.

4.3 Thickness

4.3.1 The minimum uniform thickness of sole of *hawai chappal* shall be 8 mm for all sizes. The minimum uniform sole thickness shall be measured as shown in Fig. 2.

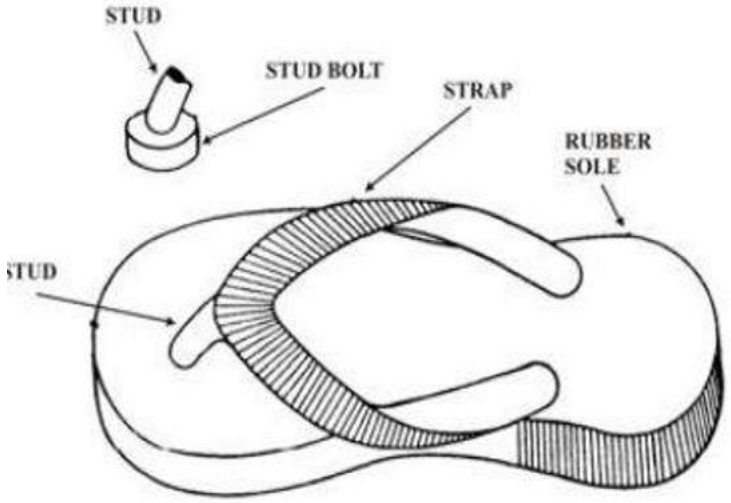


FIG. 1 ILLUSTRATED DIAGRAM OF RUBBER *HAWAI CHAPPAL* WITH STRAP

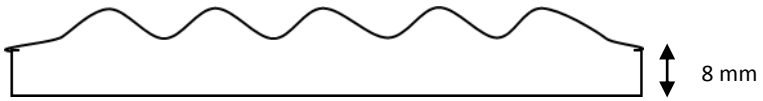


FIG. 2 MEASUREMENT OF UNIFORM SOLE THICKNESS

4.3.2 The thickness of the strap wings for *hawai chappal* shall be as agreed to between the purchaser and the manufacturer. The recommended toe post and rear hole length from the bottom of standard length is given in Annex B.

4.4 The bottom, strap material and *hawai chappal* shall conform to the requirements as prescribed in Table 1, 2, 3 and clause **5** respectively when tested in accordance with the test methods mentioned.

NOTE — Test piece - Wherever possible, for all tests, test pieces shall be cut from the finished article, where this is not possible, the manufacturer shall provide test slabs from same batch/control unit.

Table 1 Physical Requirement of Bottom Material for *Hawai Chappal*
(*Clause* 4.4)

Sl No.	Properties	Minimun Requirement	Test Method
(1)	(2)	(3)	(4)
i)	Density, g/cm^3, *Min*	0.15	Annex C
ii)	Compression set at constant stress, percent, *Max*	50	Annex D
iii)	Split tear strength, kg, *Min*	2.0	Annex E
iv)	Shrinkage at 50 ºC ± 1 ºC for 24 h for polymeric material, percent, *Max*	3.0	Annex F
	Shrinkage at 100 ºC ± 1 ºC for 1 h for rubber, percent, *Max*	3.0	
v)	Abrasion resistance at applied force 5 N, mm^3, *Max*	700	IS 15298 (Part 1)
vi)	Flexing resistance: Maximum cut growth at 50 000 flexes, mm (Test carried out at 25 ºC ± 2 ºC)	6.0	IS 3400 : Part 16

Table 1 (*Concluded*)

Sl No.	Properties	Minimum Requirement	Test Method
(1)	(2)	(3)	(4)
vii)	Hydrolysis resistance, Maximum cut growth at 50 000 flexes, mm (Applicable only for PU bottom)	6.0	IS 16645/ISO 5423

Table 2 Physical Requirement of Strap Material for *Hawai Chappal*
(*Clause* 4.4)

Sl No.	Properties	Requirement		Test Method
(1)	(2)	(3)		(4)
i)	Density, g/cm^3			Annex C
	Solid strap,	≥ 0.90		
	Cellular strap	< 0.90		
ii)	Breaking strength, kgf, *Min*	**Solid Strap**	**Cellular Strap**	Annex G
	Strap to strap and	30	10	
	Toe portion to strap	10	7	
	Elongation at break, percent (Applicable to strap to strap **(V shape)**	250	100	
iii)	Minimum cross section of the stud, mm,			
	Size 1 to 13 (adult)	6		Measurement
	Size 3 to 13 (children)	5		
	(Recommended values)			
iv)	Stud bolt, mm			
	Diameter/edge to edge length	14		Measurement
	Thickness	4		
	(Recommended values)			

NOTE — In case of requirements at Sl No. (iii) and (iv) of Table 2, the values are recommended values.

Table 3 Attachment Strength and Inter Layer Bond Strength Requirement for *Hawai Chappal*
(*Clause* 4.4)

Sl No.	Properties	Requirement	Test Method
(1)	(2)	(3)	(4)
i)	Toe post attachment strength, N, *Min*	80	Annex 'H'
ii)	Attachment strength of rear strap, N, *Min*	80	
iii)	Inter layer bond strength, N/mm, *Min* (Applicable only for multilayer pasted bottom sole)	2.0	IS 15298 : Part 1

5 CHEMICAL REQUIREMENT FOR *HAWAI CHAPPAL*

5.1 All the components of *hawai chappal* shall comply with Table 1 of IS 17011 for critical substance category I and category II as specified under **3.6** if IS 17011.

5.2 When PVC is present in *hawai chappal*, the *hawai chappal* shall be tested for lead content. Lead

content (as Pb) shall not be more than 2 ppm when tested in accordance with the method prescribed in IS 12240 (Part 5).

6 MARKING AND PACKING

6.1 Marking

6.1.1 The *hawai chappal* shall be marked legibly and indelibly with the following:

a) Size; and

b) Identification of the source of manufacturer or brand name.

6.1.2 *BIS Certification Marking*

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standard Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

6.2 Packing

The *hawai chappal* shall be packed as agreed to between the purchaser and the manufacturer. The straps shall also be marked with the side of foot, that is, right and left. Each package shall contain *chappal* of one size only and shall be marked with the name of the item, size, colour, type, identification of the source of manufacture and batch number.

7 SAMPLING

The methods of drawing representative samples of the material and the criteria for conformity shall be as prescribed in IS 6368.

ANNEX A

(*Clause* 4.2)

Table 4 Recommended Length for Standard *Hawai Chappal* Size as per IS 1638

Sl No.	Children		Adult	
	Size	Standard Length, mm	Size	Standard Length, mm
(1)	(2)	(3)	(4)	(5)
i)	3	126.50	1	220.00
ii)	4	135.00	2	228.50
iii)	5	143.50	3	237.00
iv)	6	152.00	4	245.50
v)	7	160.50	5	254.00
vi)	8	169.00	6	262.50
vii)	9	177.50	7	271.00
viii)	10	186.00	8	279.50
ix)	11	194.50	9	288.00
x)	12	203.00	10	296.50
xi)	13	211.00	11	305.00
xii)	—	—	12	313.50
xiii)	—	—	13	322.00

ANNEX B

(*Clause* 4.3.2)

Table 5 Minimum Standard Length from the Position of Toe Post and Rear End

The recommended toe post and rear hole length from the bottom of standard length is given below. It is generally measured **5/6th** of standard length for toe post hole from bottom sole and **1/5th** of standard length from the bottom sole.

Sl No.	**Children Size**	**Minimum Standard Length, mm**	**Toe Post Hole Length, mm** (Reduce **5/6th** of standard length and substract from standard length and measure from the bottom of standard length)	**Rear Hole Length, mm** (Reduce **1/5th** standard length and substract from standard length and measure from the bottom of standard length)
(1)	(2)	(3)	(4)	(5)
i)	3	126.5	105.4	25.3
ii)	4	135.0	112.5	27.0
iii)	5	143.5	119.6	28.7
iv)	6	152.0	126.7	30.4
v)	7	160.5	133.7	32.1
vi)	8	169.0	140.8	33.8
vii)	9	177.5	147.9	35.5
viii)	10	186.0	155.0	37.2
ix)	11	194.5	162.1	38.9
x)	12	203.0	169.2	40.6
xi)	13	211.0	175.8	42.2
Sl No.	**Adult Size**	**Minimum Standard Length, mm**	**Toe Post Hole Length, mm** (Reduce **5/6th** of standard length and substract from standard length and measure from the bottom of standard length)	**Rear Hole Length, mm** (Reduce **1/5th** standard length and substract from standard length and measure from the bottom of standard length)
(1)	(2)	(3)	(4)	(5)
i)	1	220.0	183.3	44.0
ii)	2	228.5	190.4	45.7
iii)	3	237.0	197.5	47.4
iv)	4	245.5	204.6	49.1
v)	5	254.0	211/7	50.8
vi)	6	262.5	218.7	52.2
vii)	7	271.0	225.8	54.2
viii)	8	279.5	232.9	55.9
ix)	9	288.0	240.0	57.6
x)	10	296.5	247.1	59.3
xi)	11	305.0	254.2	61.0
xii)	12	313.5	261.2	62.7
xiii)	13	322.0	268.3	64.4

ANNEX C

[*Table* 1 and 2, *Sl No.* (i), *Col* (4), *Clause* 4.4]

C-1 METHOD A DENSITY OF MATERIAL BY VOLUME DISPLACEMENT (SOLID/ COMPACT MATERIALS OR NON-WATER-ABSORBENT CELLULAR MATERIALS)

C-1.1 Scope

This test procedure is intended to determine the density (weight per unit volume) or 'specific gravity' of materials by measuring their volume displacement in water. This method is mainly applicable to measuring density of solid (compact) materials or non-water-absorbent cellular materials by comparing the weight of the specimen in air and in water using Archimedes principle.

C-1.2 Principle

The test specimen is first weighed in air and reweighed fully immersed in water. The apparent loss in weight is equal to the weight of water displaced. The volume displacement, equal to the volume of the test piece, is then calculated and divided into the weight in air to arrive the density.

C-1.3 Apparatus and Materials

C-1.3.1 A laboratory balance capable of measuring masses upto 200 g to the nearest 0.001 g.

C-1.3.2 Accessories suitable for density measurement along with the balance normally comprising.

C-1.3.3 A balance pan straddle of suitable size so as to support the beaker conveniently which facilitates the determination of the mass of the test specimen in water.

C-1.3.4. A beaker of 250 cm^3 capacity approximately, appropriate to the balance and straddle.

C-1.3.5 A sinker to ensure complete immersion of test specimens which are buoyant or otherwise float. This may be a small weight with provisions to attach the test specimens in a cage or cradle like arrangement within or beneath which the test specimen would be placed.

C-1.3.6 A suitable device to suspend the test specimen, with sinker in the beaker so that the test specimen and sinker do not touch either sides or bottom of the beaker. The form of this device will depend on the type of balance. Example of cradle suspended from a top hook as given in the Fig. 3.

C-1.3.7 Distilled or deionised water.

C-1.3.8 A device for cutting specimen of a suitable size.

C-1.3.9 Wetting agent such as methanol.

C-1.4 Preparation of Specimen

Use the cutting device to cut two test specimens. The shape and dimensions of each test specimen are not critical but the test specimen should have a mass of at least 2.5 g and must be capable of being fully immersed in the beaker containing water without touching the sides or bottom of the beaker. If a sinker is used, this will also limit the size of the test specimen, as too large a test specimen may be too buoyant or exceed the space available in a cage type sinker. If necessary, a test specimen may be comprised of two or more pieces used together.

Condition the test specimens and water for at least 3 h in a standard laboratory environment of (23 ± 2) °C and carry out the test in this environment.

C-1.5 Procedure

Weigh the test specimen in air in grams to the nearest milligram. Record this value as (M_a). Position the straddle over the balance pan and place the beaker with water on the straddle.

Using the suspension device, weigh the test specimen with sinker fully immersed in the water. Ensure that no air bubbles adhere to the test specimen, suspension device or the sinker. This may be achieved by dipping them momentarily into the wetting agent, taking care to minimise the transfer of wetting agent to the water by shaking off excess wetting agent before immersion in the water. Ensure that the test specimen, and sinker if used, is fully immersed in the water and that they do not touch the sides or bottom of the beaker.

Record the total weight in water of the test specimen with the suspension device, and sinker if used in grams to the nearest milligram as (M_b).

Record the weight in water of the suspension device, and sinker if used, in grams to the nearest milligram as (M_c)

Calculate the weight in water of the test specimen alone in grams to the nearest milligram as (M_w) using the formula:

$$M_w = M_b - M_c$$

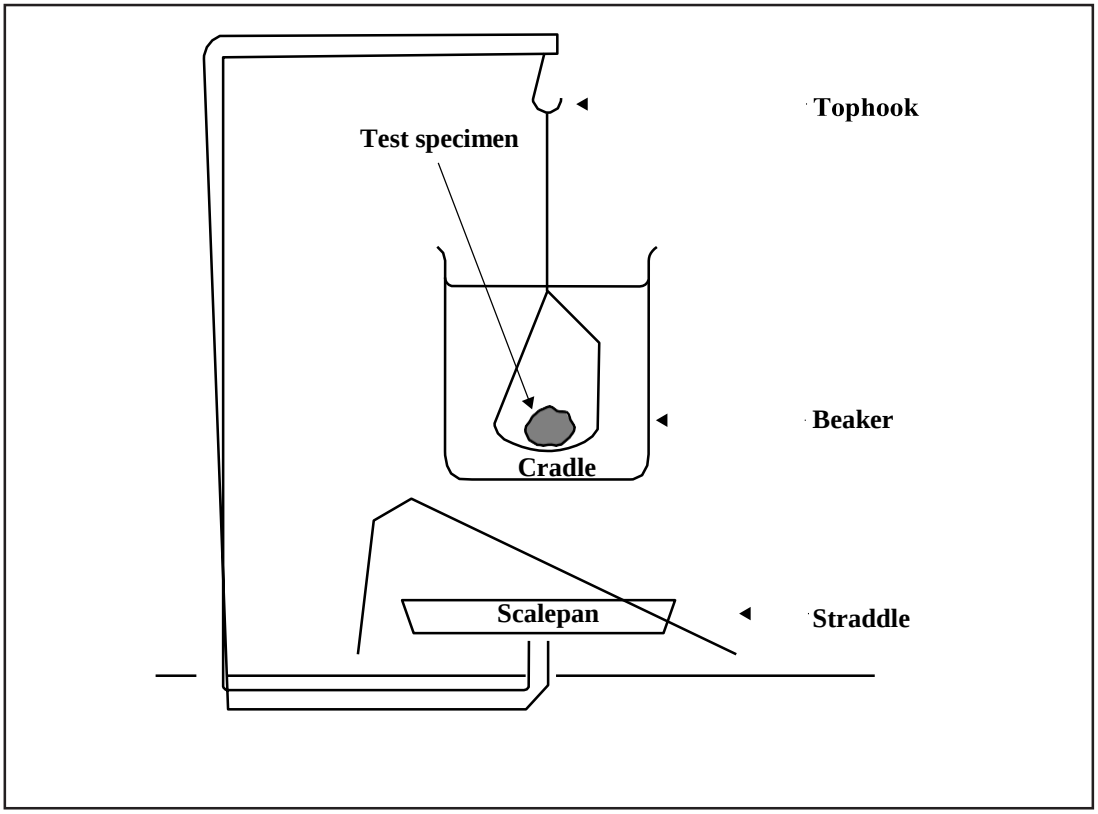


FIG. 3 A CRADLE SUSPENDED FROM A TOP HOOK

Calculate the volume of the test specimen as (V) in cm^3 to the nearest 0.001 cm^3 using the formula:

$$V = M_a - M_w$$

Calculate the density of the test specimen as (D) in g/cm^3 to the nearest 0.01 g/cm^3 using the formula:

$$D = \frac{M_a}{V}$$

If the test specimen is known or suspected to be cellular there is a possible risk of water absorption, then redetermine weight (M_a) after lightly dabbing the specimen dry with absorbent paper. If the weight (M_a) has increased by more than 0.01 g then water absorption may have taken place and the density value will be invalid. In this case, method B should be used.

NOTE — Archimedes Principle: The equivalences of the apparent loss of weight of body immersed in water and the weight of water displaced is the well-known Archimedes principle. The weight of water displaced in grams is numerically equal to the volume in cm^3 as water has the density 1 g/cm^3.

C-1.6 Report

Description of the material.

Density of the test specimen in g/cm^3,

Any deviations from this test method.

C-2 METHOD B DENSITY OF WATER ABSORBENT CELLULAR MATERIALS

C-2.1 Scope

This method is intended to determine the density of a material. The method is mainly applicable to low density cellular sheet soling materials with an open cell structure which would absorb water.

C-2.2 Principle

The dimensions of a test specimen are measured and its volume is calculated. The mass of the specimen is then measured and the average density is determined.

C-2.3 Apparatus and Material

C-2.3.1 Balance capable of measuring mass up to 200 g to an accuracy of 0.001 g.

C-2.3.2 Measuring distances up to 200 mm to an accuracy of 0.1 mm. Vernier or digital calliper capable of measuring distance.

C-2.3.3 A Standard laboratory dial thickness gauge for rubber, which applies a pressure on the test specimen of 22 kPa ± 5 kPa.

C-2.3.4 A device for cutting rectangular or circular test specimens of a suitable size.

C-2.3.5 A suitable press knife or a band saw.

C-2.4 Preparation of Test Specimen

If the sheet material has a patterned or rough surface, remove this surface completely so that the thickness of the sheet, in the area from where the test specimen is to be cut is consistent to an accuracy of 0.1 mm. The thickness of the test specimen should be as large as possible to maximise the accuracy of the results.

For cellular solings with a smooth solid surface skin on the wearing surface, remove a layer 0.5 mm thick from this side, or a little more if some of the skin remains. Then remove the rest from the reverse side. However, if the wearing surface is already a split cellular layer, do not remove the 0.5 mm layer. Where the cellular sole has a surface pattern remove this completely before removing the 0.5 mm layer.

Store the uncut sheet material in a temperature controlled environment of (25 ± 2) °C for at least 3 h before cutting the test specimen from it. If possible, carry out the test in controlled environment (25 ± 2) °C also, otherwise commence testing immediately the specimen is removed from this environment.

Use the device to cut a rectangular or circular test specimen from the sheet of material. If possible, the largest surfaces of the test specimen should each have an area of approximately 0.01 m^2 and be as square as possible. A square 100 mm × 100 mm is suitable. If not possible to cut a test specimen of this size, then cut as large a test specimen as possible but at least 10 mm × 10 mm.

A circular specimen 50 mm diameter is suitable. If not possible to cut a test specimen of this size, then cut as large a test specimen as possible but at least 10 mm diameter.

C-2.5 Procedure

C-2.5.1 Use the balance to measure the mass of the test specimen in grams to an accuracy of 0.001 g and record this value as (F).

C-2.5.2 Use the thickness gauge to measure the thickness of the test specimen in millimetre to the nearest 0.01 mm. The thickness should be measured at five places that is one near each corner and one at the centre. When recording measurements near the corners of the test specimen, ensure that the presser foot of the thickness gauge is not overhanging the edge of the test specimen.

C-2.5.3 Calculate the arithmetic mean of the five thickness readings and record this value as (T) to the nearest 0.01mm.

C-2.5.4 Use the device to measure the lengths (L) of the two shorter edges of the test specimen in mm to an accuracy of 0.1 mm. For each edge, make two measurements, one close to the top surface of the test specimen and one close to the bottom surface. Record these measurements while applying negligible pressure to avoid compressing the test specimen.

C-2.5.5 For width (W), calculate the arithmetic mean of the four measurements and record this value to an accuracy of 0.1 mm.

C-2.5.6 Repeat the procedure for the two longer edges of the test specimen and record the mean values (L).

C-2.5.7 Use the device to measure the diameter (D) circular test specimen in mm to an accuracy of 0.1 mm if circular specimen is used. Make three measurement, calculate mean of three measurement and record this value.

C-2.5.8 Calculate the density of the test specimen in g/cm^3 to two decimal places using the formula.

C-2.6 Rectangular or Square Specimen

$$\text{Density (g/cm}^3\text{)} = 1\,000 \times \frac{(F)}{(T)} \times (W) \times (L)$$

where

F = Mass of the test specimen in grams;

T = Arithmetic mean of the five thickness readings in mm;

W = Arithmetic mean of the four width measurements; and

L = Length of the two shorter edges of the test specimen in mm.

C-2.7 Circular Specimen

$$\text{Density (g/cm}^3\text{)} = (F) \times \frac{4\,000}{3.14} \times (D) \times (D) \times (T)$$

C-2.8 Report

Description of the material.

Density of the test specimen in g/cm^3,

Any deviations from this test method.

ANNEX D

[*Table* 1, *Sl. No* (ii), *Col* (4), *Clause* 4.4]

COMPRESSION SET (STATIC)

There are two methods used to measure compression set at constant stress that is method A and method B. In case of any dispute, method A shall be the referee method.

METHOD A

D-1 COMPRESSION SET – CONSTANT STRESS METHOD

D-1.1 Scope

This method is intended to determine the compression set of a material. This is a measure of retention of shape and elastic properties. The method is mainly applicable to solid and cellular footwear soling materials, but can be used with any type of compressible material.

D-1.2 Principle

The percentage change in thickness of a test specimen is calculated after it has been compressed by a predefined pressure for a set time and allowed to recover for a further set time.

D-1.3 Apparatus and Materials

D-1.3.1 A standard laboratory dial thickness gauge for means of applying a pressure of 22 kPa ± 5 kPa for materials of hardness equal to or greater than 35 IRHD (International Rubber Hardness Degree) or a pressure of 10 kPa ± 2 kPa for materials of hardness less than 35 IRHD with the capability of measuring to the nearest 0.01 mm.

D-1.3.2 A platen press, which is capable of applying and maintaining for a period of 24.0 h ± 0.2 h a pressure of

For Solid materials: 11.1 MPa ± 0.2 MPa

For Cellular materials: 0.69 MPa ± 0.02 MPa

to the surface of three test specimens with the dimensions specified, spring loaded press, for which the force/spring compression relationship is known.

D-1.3.3 For testing several types of material at the same time, rigid spacer plates are required to be placed between the different types of specimen. These should be at least three times the diameter of the test specimen across their smallest dimension.

D-1.3.4 A rotating circular cutter of diameter:

For Solid materials: 14.5 mm ± 0.5 mm

For Cellular materials: 29.0 mm ± 0.5 mm

D-1.4 Preparation of Test Specimens

D-1.4.1 Select the appropriate thickness for the test material, and use the procedure mentioned in **1.4.2** and **1.4.3** to prepare the material and reduce its thickness to the required level.

D-1.4.1.1 For each material to be tested, use the appropriate circular cutter to cut a sufficient number of circular test specimens of diameter:

For Solid materials: 14.5 mm ± 0.5 mm

For Cellular materials: 29.0 mm ± 0.5 mm

D-1.4.2 To produce three stacks each of height:

D-1.4.2.1 *Method 1* — Solid materials: 6.3 mm ± 0.3 mm, by using:

(One test specimen of thickness 6.3 mm ± 0.3 mm or two test specimens of thickness 3.2 mm ± 0.1 mm or three test specimens of thickness 2.1 mm ± 0.1 mm).

D-1.4.2.2 *Method 2* — Cellular materials: 9.5 mm ± 0.5 mm, by using:

(One test specimen of thickness 9.5 mm ± 0.5 mm or two test specimens of thickness 4.8 mm ± 0.2 mm or three test specimens of thickness 3.2 mm ± 0.1 mm).

D-1.4.2.2.1 The faces of the test specimens must be flat and parallel and the walls should not be markedly tapered, cupped or barreled.

D-1.4.3 If more than one test specimen is required to produce a stack of sufficient height, then place the appropriate number of test specimens centrally on top of each other. As far as possible, test specimens should be selected and grouped so that the total thickness of each of the stacks is similar. The test specimens in each stack should be kept together in the same order, without reversal or rotation relative to one another. The stacks will subsequently be referred to as test specimen stacks.

D-1.4.4 Check the surfaces of the presser foot and anvil of the dial thickness gauge and clean them if necessary. Set the gauge so that it reads zero.

D-1.4.5 Store the test specimens or test specimen

stacks in a standard controlled environment of either (23 ± 2) °C or (20 ± 2) °C for at least 5 h before testing and carry out the test in this environment. Include details of the conditions used in the test report.

D-1.5 Procedure

D-1.5.1 Check the surfaces of the presser foot and anvil of the dial thickness gauge and clean them if necessary. Set the gauge so that it reads zero.

D-1.5.2 Position a test specimen, or test specimen stack centrally between the presser foot and anvil of the appropriate thickness gauge.

D-1.5.3 Gently lower the presser foot onto the centre of the surface of the test specimen, wait for 5 s ± 1 s and then record the reading on the thickness gauge to the nearest 0.01 mm.

D-1.5.4 Repeat the procedure for the remaining test specimens, or test specimen stacks.

D-1.5.5 For each material being tested, calculate the arithmetic mean of the thickness readings made and record this value as (T_0) to the nearest 0.01 mm.

D-1.5.6 Place the three test specimens, or test specimen stacks, on the lower platen of the press so that the centres of the test specimens form an equilateral triangle, with the edges of adjacent test specimens approximately 5 mm apart and the centre of the triangle aligned with the centre of the platen, *see* Fig. 4.

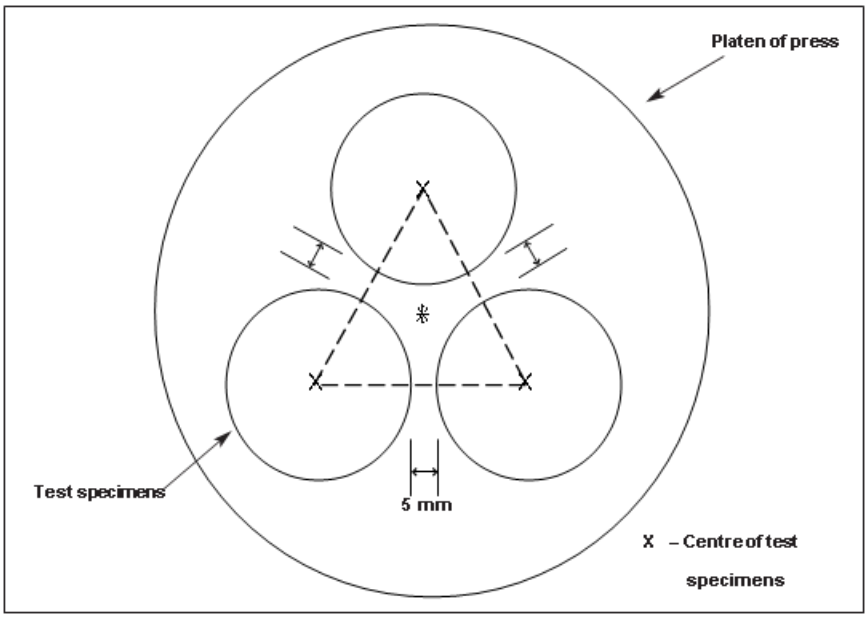


FIG.4 PLAN VIEW OF TEST SPECIMENS AND PLATEN

D-1.5.7 Several materials can be tested at the same time provided that they are either all solid materials or all cellular materials. If testing several materials at the same time then place as pacer plate on top of the test specimens and repeat the procedure as said earlier.

D-1.5.8 Placing three test specimens, or test specimen stacks, on top of the spacer plate instead of the lower platen. Each layer shall only consist of test specimens cut from one material.

D-1.5.9 Repeat the procedure for any remaining materials to be tested using as pacer plate between each layer of test specimens.

Operate the press to apply a nominal pressure, assuming the test specimen to be of target diameter

For Solid materials: 11.1 MPa ± 0.2 MPa

For Cellular materials: 0.69 MPa ± 0.02 MPa

to each test specimen, or test specimen stack. For a spring loaded press such as the force (F) applied between the platens will be indicated by the compression of the springs. If (A) is the area of each test specimen in mm^2 then the force in Newton required producing a pressure of (P) in mega Pascal's can be calculated by using the formula:

$$(F) = (P) \times 3 \times (A)$$

This gives, for the standard test specimen diameters:

For Solid materials: (F) = 5 500 N ± 100 N

For Cellular materials: (F) = 1 370 N ± 40 N

After 24.0 h ± 0.2 h release the press and remove the test specimens.

Allow the test specimens to recover for 1.0 h ± 0.1 h.

For each material tested, repeat the procedure as stated earlier but record the thickness as (T_1) to the nearest 0.01 mm.

For each material tested, calculate the percentage compression set, to the nearest one percent, using the formula:

D-1.6 Calculations

$$\text{Percentage of compression set} = (T_0) - \frac{(T_1)}{(T_0)} \times 100$$

where

T_0 = Arithmetic mean of the thickness of test piece in mm, before compression; and

T_1 = Arithmetic mean of the thickness of test piece in mm, after compression.

D-1.7 Report

Reference to this test method.

The version of the test used: Method 1 or Method 2.

A description of the material(s) tested.

The compression set, as calculated.

Any deviations from this standard test method.

D-1.8 Additional Note

D-1.8.1 *Preparation of the Test Specimens*

Reduce the original material, which may be in the form of sheets, or cut or moulded soles, to its test thickness using either a band knife splitter or a surface grinder.

The preparation of test pieces from soling materials for physical testing). During preparation, check the thickness of the soling with the rubber dial thickness gauge.

D-1.8.2 Solid solings with a smooth wearing surface: Remove all the excess material from the reverse surface.

Solid solings with a surface pattern: First remove this pattern completely and then remove the rest of the excess material from the reverse side until the required thickness is obtained. The surface pattern must still be removed even if the final thickness of the sheet will be below the standard test thickness.

D-1.8.3 Cellular soling with a smooth solid surface skin on the wearing surface: Remove a layer of 0.5 mm thick from this surface or a little more if some of the skin remains. Then remove the rest of the excess material from the reverse surface. If however, the wearing surface is already an exposed cellular layer, do not remove the 0.5 mm layer. Where the cellular soling has a surface pattern, remove this completely before removing the 0.5 mm layer.

METHOD B

D-2 DETERMINATION OF AT CONSTANT STRESS COMPRESSION SET

D-2.1 Compression Set at Constant Stress

D-2.1.1 *Apparatus*

The compression apparatus shall consist of two parallel flat, rigid plates between which the test pieces may be compressed and the means of applying slowly a load of 140 kg ± 1 kg to the plates and maintaining the load for a period of at least 24 h. Alternatively, the single loading spring may be replaced by a set to three equivalent springs placed symmetrically around the central axis.

D-2.1.2 *Test Piece*

Cut three discs of diameter 30 mm ± 0.2 mm of any thickness from sheets soles.

D-2.1.3 *Procedure*

Condition the test pieces at 27 °C ± 2 °C and 65 percent ± 5 percent relative humidity for 24 h. Measure the initial thickness of each test piece at the centre using the gauge with part-Spherical contact. Note the arithmetic mean of the three readings as the initial thickness. Place the three test pieces symmetrically between the parallel plates of the compression apparatus and subject to a compression load of 140 kg ± 1 kg for 24 h. Then release the load, remove the test pieces and allow to recover. After one hour remeasure the thickness and note the arithmetic mean as the final thickness.

D-2.l.4 Expression of Results

The compression set is the difference between the original thickness of the test piece and that after recovery expressed as a percentage of the initial thickness.

$$\text{Compression set, percent} = (t_O - t_i) \times \frac{100}{t_i\, t_O}$$

where

t_o = The initial thickness in mm; and

t_i = The final thickness in mm.

ANNEX E

[*Table* 1, *Sl No.* (iii), *Col* (4)]

METHOD OF DETERMINATION OF SPLIT TEAR STRENGTH

E-1 APPARATUS

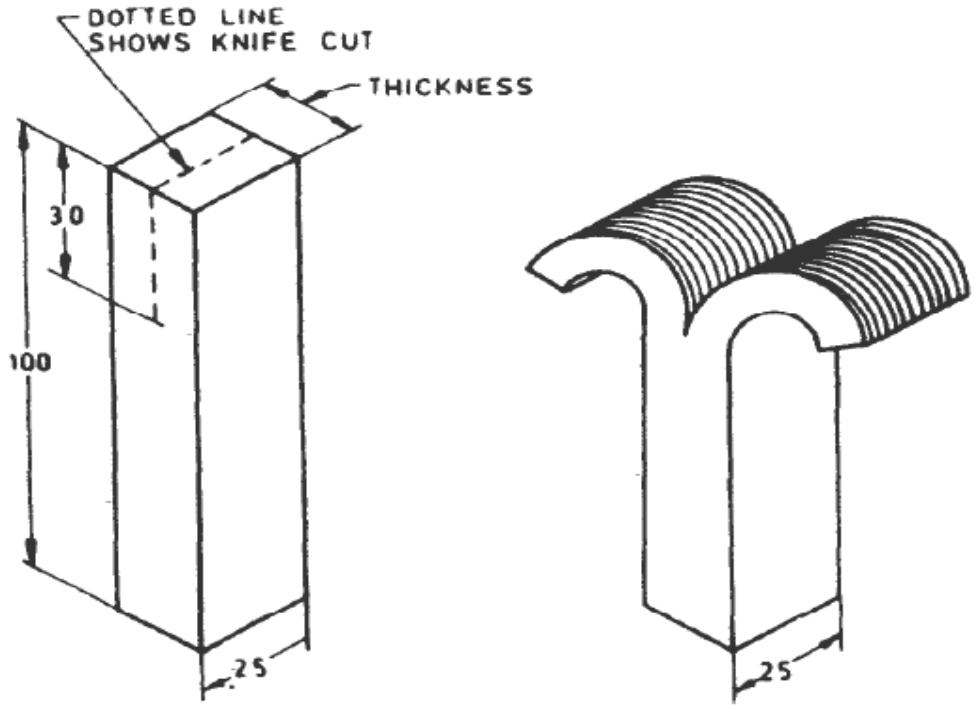
E-1.1 Tensile Testing Apparatus — with rate of traverse of 75 mm per minute.

E-2 TEST PIECE

Cut three test pieces of 25 mm × 100 mm along and across the direction of the sheet. Prepare each test piece by splitting it midway between the top and the bottom surface for a distance of 30 mm from one end and thus form two tongues at the end. The test pieces before and after knife cut have been shown in Fig. 5 A and 5 B.

E-3 PROCEDURE

Clamp the tongue of the test piece in the jaws of the tensile testing apparatus and allow the jaws to separate at a constant rate of 75 mm per minute. Note the maximum load and record the arithmetic average of three tests in kg as the split tear strength.



5 A (Test piece before knife cut) 5 B (Test piece after knife cut)

FIG. 5 TEST PIECE FOR SPLIT TEAR STRENGTH

ANNEX F

[*Table* 1, *Sl No.* (iv), *Col* (4)]

METHOD OF TEST FOR DETERMINATION OF SHRINKAGE

F-1 TEST PIECE

Cut test piece of minimum dimensions 150 mm × 25 mm from post cured sheet or sole by means of a knife.

F-2 CONDITIONING OF TEST PIECE

Condition the test piece at 27 °C ± 2 °C temperature and 65 percent ± 5 percent relative humidity for 24 h prior to testing.

F-3 NUMBER OF TESTS

Carry out tests on at least three test pieces.

F-4 PROCEDURE

Trace the test piece on a piece of white paper. Measure the length of the test piece from paper to the nearest 0.1 mm. Keep the test piece suitably in an oven (thermostatically controlled) for 24 h at (50 ± 1) °C for polymeric material and (100 ± 1) °C for rubber material. Take out the piece from the oven and cool until the temperature comes down to ambient temperature. Keep the test piece at room temperature for minimum 2 h. Trace it again on the same paper and measure the length of the test piece on the paper.

F-5 CALCULATION

Calculate the shrinkage as follows:

$$\text{Shrinkage, percent} = L_0 - \frac{L_1}{L_0} \times 100$$

where

L_0 = Length of test piece, in mm, before heating; and

L_1 = Length of test piece, in mm, after heating and cooling at room temperature.

ANNEX G

[*Table* 2, *Sl No.* (ii), *Col* (4)]

DETERMINATION OF BREAKING STRENGTH AND EXTENSION AT BREAK

G-1 SCOPE

This method is intended to determine the force required and its extension at break of strap. The method is applicable to any types of strap used in *hawai chappal*.

G-2 PRINCIPLE

Hawai chappal strap is gradually stretched by a tensile testing machine, until it fails. The breaking strength and the extension at break both are determined.

G-3 APPARATUS AND MATERIALS

A tensile testing machine capable of measuring force of 2 kN to an accuracy of 2 percent and with jaw separation 500 mm/min ± 20 mm/min.

A press knife or other means of cutting test specimens to required size.

A device for measuring distances upto 100 mm to an accuracy of 0.5 mm. A steel rule or Vernier callipers are suitable.

G-4 PREPARATION OF TEST SPECIMEN

G-4.1 Strap to Toe Post

Cut the three specimen of strap from the product (*hawai chappal*) without damaging strap or if strap component submitted separately use three strap specimen for strap to toe post test.

G-4.2 Strap to Strap

Cut three specimen of linear portion of strap from *hawai chappal* (product) or if strap component submitted separately for a length at least 100 mm for strap to strap test.

Store the test specimens in a standard controlled environment of either of 25 °C ± 2 °C and 65 percent ± 5 percent RH for minimum of 24 h prior to testing.

G-5 PROCEDURE

G-5.1 Strap to Toe Post-Breaking Strength

Adjust the tensile testing machine so that the jaws are 50 mm ± 1 mm apart.

Insert one end of the strap in the upper jaws and other end of the strap in the lower jaw of tensile testing machine and clamp it, the lines are aligned at the clamping edge as shown in the Fig. 6, so that that load acting centre of the toe portion of strap (V-shaped).

Operate the tensile testing machine so that the jaws separate at a speed of 500 mm/min ± 20 mm/min.

Stop the machine when the test specimen break.

Record the breaking force (F) in Newton to the nearest 5 N.

Repeat the procedure a further two times for the other two specimens.

Calculate the arithmetic mean of the three breaking strength values.

G-5.2 Strap to Strap - Breaking Strength and Extension a Break

Adjust the tensile testing machine so that the jaws are 50 mm ± 1 mm apart.

Insert one end of linear portion of the strap in the upper jaws and other end of the linear portion of strap in the lower jaw of tensile testing machine and clamp it, the lines are aligned at the clamping edge as shown in the Fig. 7, so that load acting centre portion of strap at linearly.

Operate the tensile testing machine so that the jaws separate at a speed of 500 mm/min ± 20 mm/min. Stop the machine when the test specimen breaks.

Record the breaking force and extension at break.

Breaking Force (F) in Newton to the nearest 5 N.

Extension at break (E) in millimetres to the nearest 1 mm.

Repeat the procedure a further two times for the other two specimens.

Calculate the arithmetic mean of the three breaking strength values.

For each test specimen calculate the percentage extension at break, using the formula:

$$\text{Elongation at break, percent} = (E) \times \frac{100}{(GL)}$$

where

GL is the initial jaw separation of the tensile testing machine 50 mm.

Calculate the arithmetic mean of the three extensions at break values.

Repeat the procedure for the three test specimens.

G-6 REPORT

A description of the material,

The mean breaking force as determined.

The mean extension at break as determined.

Any deviations from this standard test method.

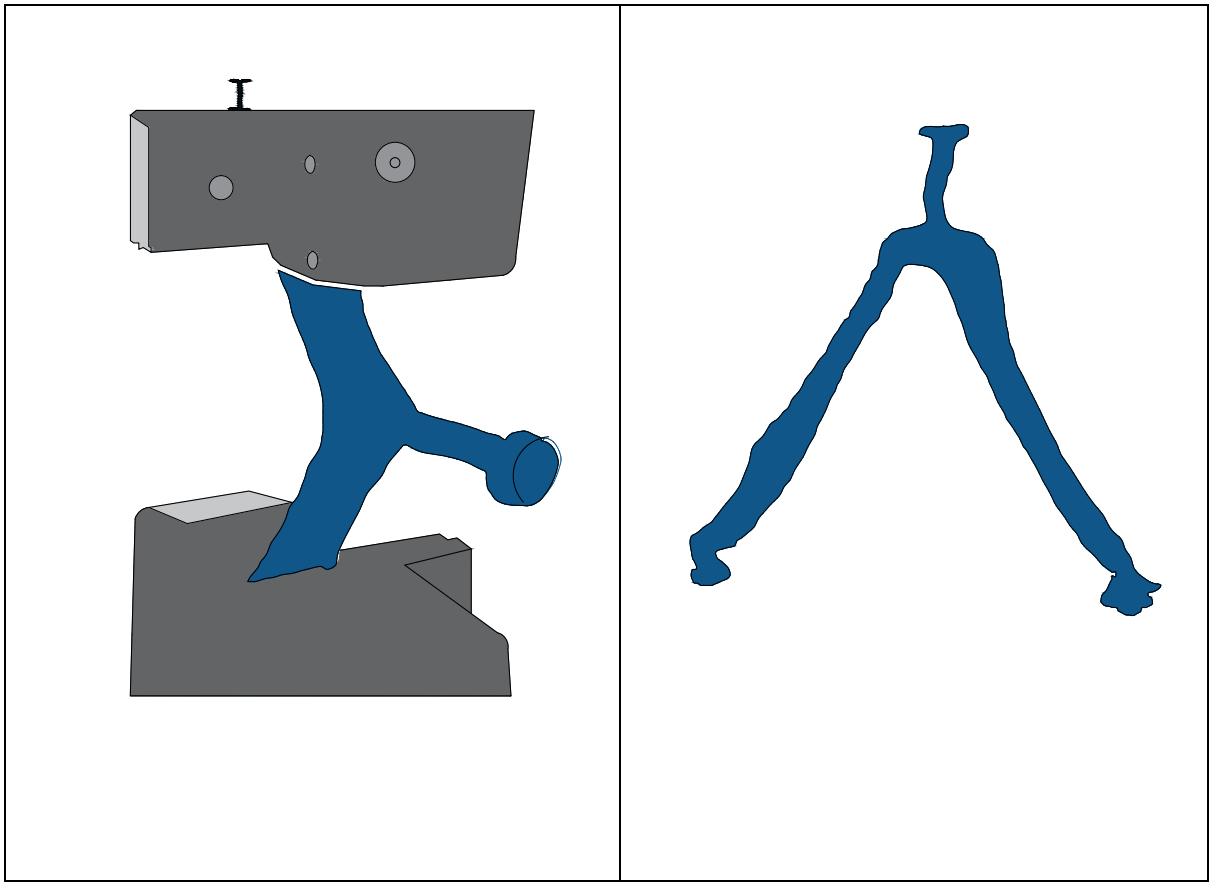


FIG. 6 ILLUSTRATION DIAGRAM FOR CLAMPING OF STRAP TO TOE POST SAMPLE TO BE FIXED IN TENSILE TESTING MACHINE

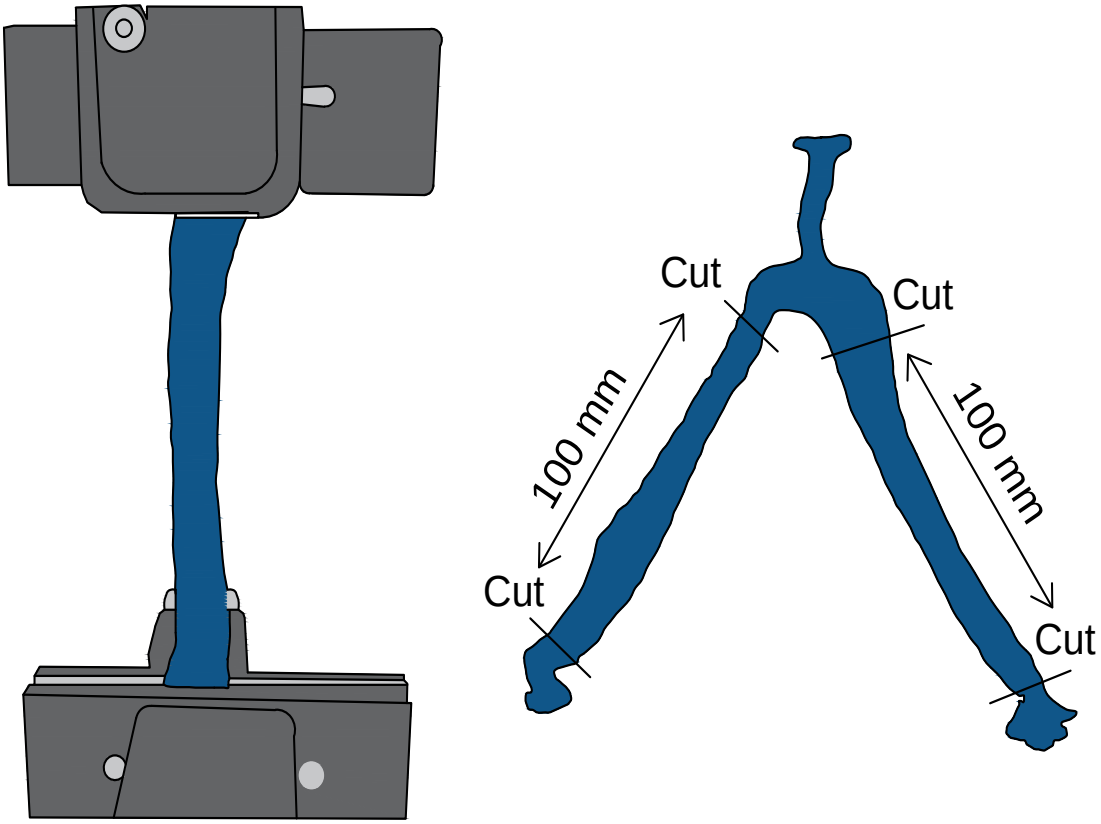


FIG. 7 ILLUSTRATION DIAGRAM FOR CLAMPING OF STRAP-TO-STRAP SAMPLE TO BE FIXED IN TENSILE TESTING MACHINE

Annex H

[*Table* 3, *Sl No.* (i) and (ii), *Col* (4)]

ATTACHMENT STRENGTH OF TOE POST AND REAR STRAP

H-1 SCOPE

This method is intended to determine the strength of toe post and rear strap and its attachment. The method is applicable to all types of *hawai chappal* with a toe post and rear strap.

H-2 PRINCIPLE

A thin rigid square template with a hole close to each corner and a key hole shaped slot to accommodate the toe post and rear strap is placed around the toe post and rear strap on the top surface of bottom sole of the test *chappal*. Four holes which match the holes in the template are drilled in the bottom sole. Two loops of thick wire or lace are threaded through both the template and sole. The assembly is then fitted between the jaws of a tensile testing machine and the force required to pull the toe post and rear strap from the bottom sole is measured.

H-3 APPARATUS AND MATERIAL

H-3.1 tensile testing machine capability of measuring force of 2 kN to an accuracy of 2 percent and with jaw separation 100 mm/min ± 10 mm/min.

H-3.2 A press knife or other means of cutting test specimens to require size.

H-3.3 A lower jaw capable of clamping all four free ends of the wire loops or suitable lace and at the same time an upper jaw capable of clamping the side straps attached to the top of the toe post and top of rear strap of the test *hawai chappal*.

H-3.4 A rigid template produced from thin metal or fibre board with the dimensions. Two loops of wire diameter 3.0 mm ± 0.2 mm, or suitable lace may be used of the dimensions shown in Fig. 8.

H-3.5 A twist drill bit of diameter 4.0 mm ± 0.5 mm.

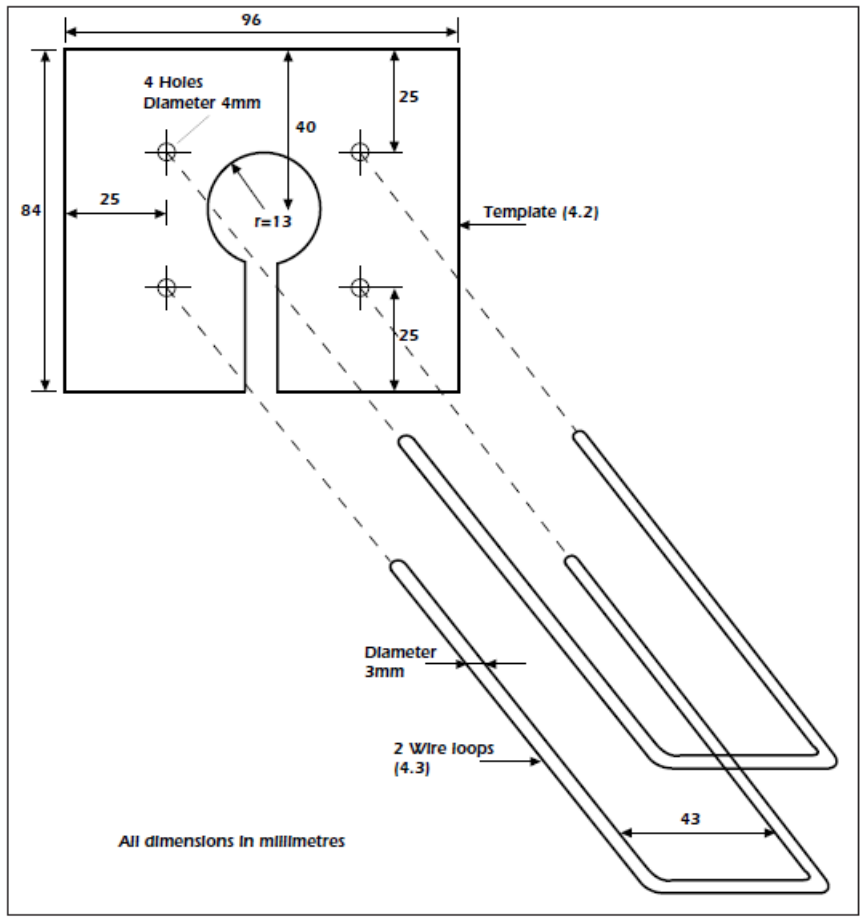


FIG. 8 STEEL TEMPLATE AND WIRE LOOP

H-3.6 A hand or electric drill.

H-4 PREPARATION OF THE TEST SPECIMEN

Two pair of complete product of *hawai chappal* required for testing.

H-5 PROCEDURE

Store the *hawai chappal* to be tested in a standard controlled environment of (23 ± 2) °C and 50 percent ± 4 percent RH for at least 48 h before testing and carryout the test at room temperature.

Cut away any side straps from the sole while leaving a sufficient length attached to the top of the toe post and rear strap to be firmly secured in the upper jaw of the tensile testing machine.

Place the template on the top surface of the bottom sole of the *hawai chappal* so that the toe post and the rear strap is in the center of the key hole slot. The template should be positioned so that it does not cover any area where the toe post and rear strap is lying between the bottom sole.

Without moving, the template mark the top surface of bottom sole at the centers of the four holes in the template. Then remove the template from the bottom sole. Use the drill and drill bit to four holes through the bottom sole of the *hawai chappal* in the positions marked.

Replace the template on the top surface of the bottom sole of *hawai chappal* in the position marked so that all four holes in the template are aligned with the four holes in the bottom sole.

Thread the two wire loops through the holes in the template to bottom sole of *hawai chappal* from the template side of the assembly.

Clamp the four free ends of the two wire loops or lace in the lower jaw of the tensile testing machine, and the free ends of the side straps attached to the toe post and rear strap in the upper jaw as shown in the Fig. 9 and 10.

Operate the tensile testing machine so that the jaws separate at a rate of 100 mm/min ± 10 mm/min until either the toe post breaks/rear strap break, or pulls out of the bottom sole.

Record the maximum force obtained in Newton, record the type of failure.

Repeat the procedure on remaining tests for the toe post attachment and rear strap attachment strength for *hawai chappal*.

H-6 TEST REPORT

A full description of the tested sample.

The maximum force(s) recorded and the type(s) of failure,

Any deviations from this standard test method.

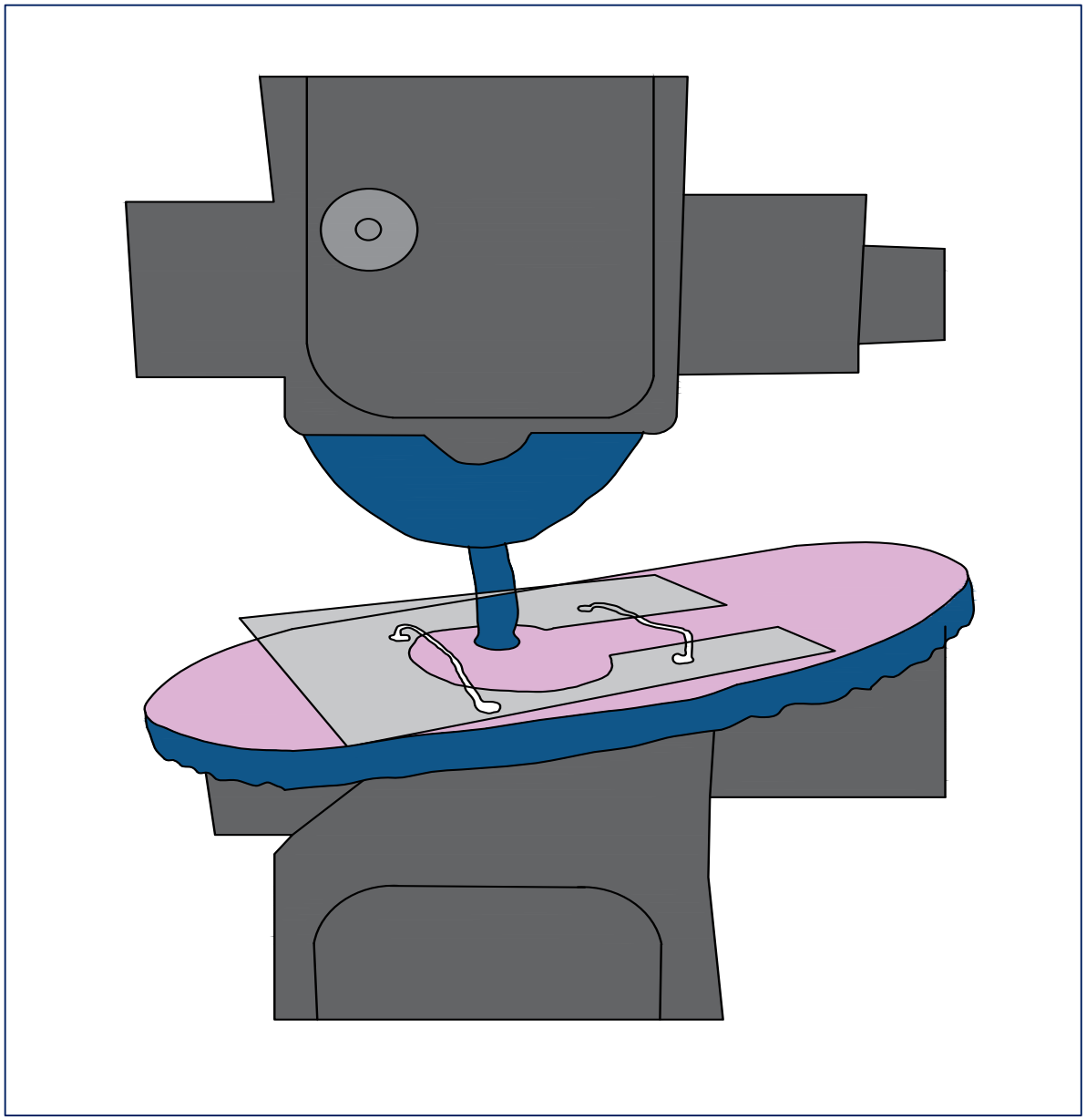


FIG. 9 ILLUSTRATION DIAGRAM FOR CLAMPING OF TOE POST STRAP IN THE TENSILE MACHINE

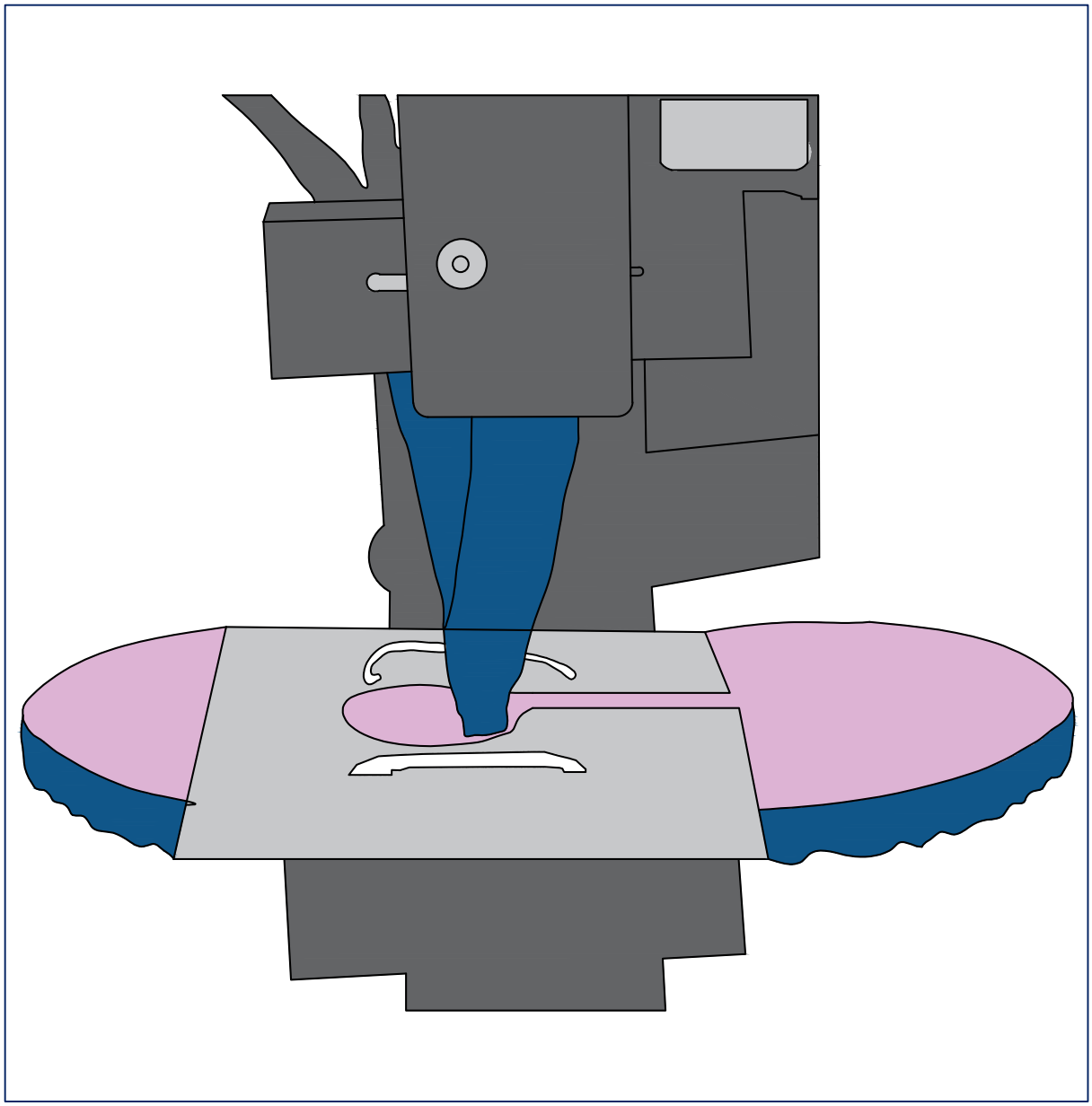


FIG. 10 ILLUSTRATION DIAGRAM FOR CLAMPING OF REAR STRAP IN THE TENSILE MACHINE

ANNEX J

(*Foreword*)

COMMITTEE COMPOSITION

Footwear Sectional Committee, CHD 19

Organization	*Representative(s)*
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Review of Indian Standards

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Amendments Issued Since Publication

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